Controls on Lunar Basaltic Volcanic Eruption Structure and Morphology: Gas Release Patterns in Sequential Eruption Phases. L. Wilson[1,2] and J. W. Head[2] [1]Lancaster Environment Centre, Lancaster University, Lancaster LA1 4YQ, UK; [2]Department of Earth, Environmental and Planetary Sciences, Brown University, Providence, RI 02912 USA

Assessment of mare basalt gas release patterns during individual eruptions provides the basis for predicting the effect of vesiculation processes on the structure and morphology of associated features. We subdivide typical lunar eruptions into four phases: *Phase 1*, initial penetration of a gas/foam-rich dike tip to the surface in a very explosive venting phase lasting minutes and producing thin, very widespread pyroclastic deposits; *Phase 2*, continued dike rise causing a very high magma discharge rate and nearly steady explosive eruption of magma containing a uniform distribution of released volatiles, efficiently lost in a predominantly optically dense hawaiian fire fountain, with sub-mm pyroclastic droplets falling back into a vesicle-free lava lake surrounding the vent; lava initially flows turbulently away from the lava lake to form sinuous rilles or the distal parts of extensive flow fields; *Phase 3*, the dike reaches equilibrium, vertical extent is fixed, magma rise rate is driven by lower internal pressure and dike closure and decreases radically; gas bubbles now rise faster than magma, coalesce and grow, causing a transition from hawaiian to strombolian activity and continuing until most deep-sourced gas is exhausted and explosive activity is minimal; *Phase 4* (small total dike volume option), a stable crust forms on still-emerging lava flowing away from vent and consisting of magma with vesicles from H_2O and S species released in the upper ~500 m of the dike; in the vacuum, the upper highly vesiculated part of the flow forms a bubble-wall fragment shard layer, overlying a vesicle-rich layer, above a lava layer still containing dissolved volatiles; this flows at a low flux for a duration controlled by the magnitude and state of global stresses closing the dike and by cooling of the dike magma, which limits the duration of this phase to at most 1-2 years. *Phase 4* (large total dike volume option), in the case of vertically extensive dikes, a large fraction of the total dike magma is still available for extrusion as vesicular lava; such lava is likely to intrude into the still-hot interiors of previously-emplaced non-vesicular flows causing them to inflate, in a manner similar to flood-basalt lava fields on Earth, and to then undergo volatile release through second boiling upon cooling, with the resulting new population of gas bubbles causing a further, possibly extensive, inflation episode. We show how these four phases of mare basalt volatile release, together with total dike volumes, initial magma volatile content, vent configuration and magma discharge rate, can help relate the apparently disparate and wide range of lunar volcanic features to a common set of eruption processes. These phases result in a unifying conceptual model for the relationships among a wide and diverse range of related observed volcanic landforms and structures (pyroclastic mantles, small shield volcanoes, compound flow fields, sinuous rilles/source depressions, long lava flows, pyroclastic cones, summit pit craters, irregular mare patches (IMPs), and ring moat dome structures (RMDSs). These theoretical predictions provide the basis for placing lunar volcanic landforms into eruptive sequences, instead of viewing each in isolation.